

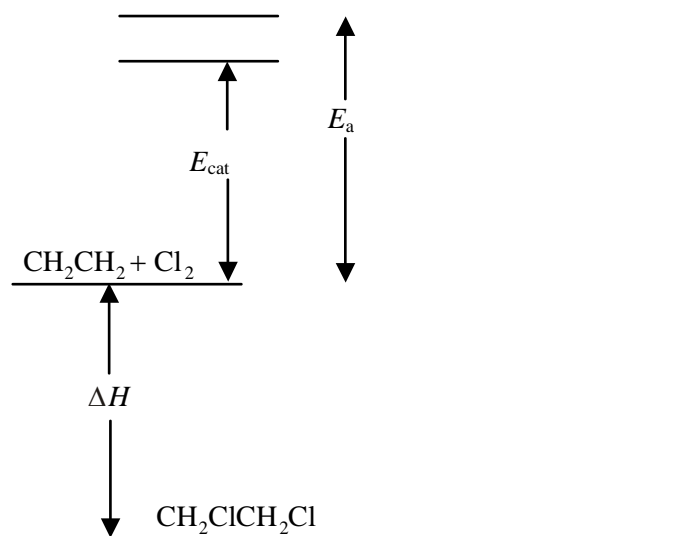
## T16D08 – 16.2/3 HL IB Review MS

1. D
2. C
3. B
4. (a)

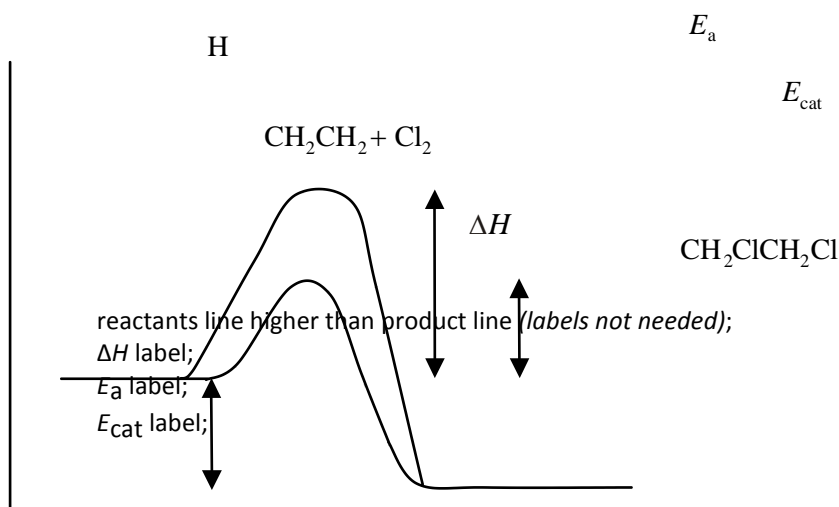
- (i) it relates to the geometric requirements of the reaction/orientation of reactants on collision/*OWTTE*; 1
- (ii) minimum energy needed for reactants to react (on collision)/*OWTTE*; 1
- (iii)  $k$  measured at different values of temperature;  
graph plotted of  $\ln k$  against  $1/T$ ;  
intercept on y-axis is  $\ln A$ ;  
 $A = e^{\text{intercept}}$ ;  
measured slope of graph =  $-E_a/R$ ;  
 $E_a = -R \times \text{gradient}$ ; 5

*Award [1] each for any five.*

- (b) (i) homogeneous catalyst is in same phase as reactants and heterogeneous catalyst is in different phase from reactants; 1
- (ii) 4



OR



[12]

5. (a) (order with respect to)  $\text{H}_2 = 1$ ;  
(order with respect to)  $\text{NO} = 2$ ; 2
- (b)  $\text{rate} = k[\text{H}_2][\text{NO}]^2$ ; 1  
*ECF from (a).*
- (c)  $(2.53 \times 10^{-6} \text{ mol dm}^{-3} \text{ s}^{-1} = k(0.100 \text{ mol dm}^{-3})(0.100 \text{ mol dm}^{-3})^2)$   
 $k = 2.53 \times 10^{-3}$ ;  
 $\text{mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$ ; 2  
*ECF from (b).*
- (d) agrees/yes;  
slow step depends on X and NO;  
(so) NO is involved twice and  $\text{H}_2$  once;  
overall equation matches the stoichiometric equation/OWTTE;  
*ECF for "no", depending on answer for (b).*
- OR**  
agrees/yes;  
and  $\frac{[\text{X}]}{[\text{H}_2][\text{NO}]} = \text{constant}$ ;  
rate of slow step =  $k[\text{X}][\text{NO}]$ ;  
but X depends on  $\text{H}_2$  and NO;  
rate of slow step =  $k[\text{H}_2][\text{NO}]^2$ ; 4 max  
*Award [1] each for any three of the four above.*  
*ECF for "no", depending on answer for (b).*
- (e) reaction involves four molecules;  
statistically/geometrically unlikely; 2
- (f) the rate of formation of  $\text{H}_2\text{O} = 2 \times \text{rate for } \text{N}_2$ ;  
because 2 moles  $\text{H}_2\text{O}$  formed with 1 mole  $\text{N}_2$ /OWTTE; 2

**[13]**